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(54) Manufacture of spark plugs

Herstellung von Zündkerzen

Fabrication de bougies d'allumage

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(56) References cited:
DD-A- 108 857 **US-A- 2 215 333**

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Description

This invention relates to apparatus for manufacturing spark plugs, and to a method of manufacturing spark plugs. In particular the invention is concerned with the forming and positioning of the side electrode of a spark plug.

Conventionally, the side electrode is welded to the metal shell of the plug, with the electrode in a straight condition. The electrode is then bent over to produce the desired spark gap between the centre electrode and the side electrode.

It is known, for example from DDR patent specification number 108 857 dated 19.12.1973, to place a gauging tool on the centre electrode, and then to use a roller or other tool to bend over the side electrode until it makes contact with the gauge.

It is very well known that the spark gap between the two electrodes is a critical dimension. What is not so often realised that it is also important that the free end of the side electrode should be uniformly positioned relative to the centre electrode in a plane transverse to the axis of the plug. It is an object of the present invention to control both the spark gap and the transverse position of the free end of the side electrode, during the manufacture of the spark plug.

According to a first aspect of the invention therefore, there is provided a method of positioning the side electrode of a spark plug after the electrode has been welded to a spark plug shell, the method comprising the step of first bending the free end of the electrode toward the plug axis, characterised by the further steps of stopping further transverse movement of the end relative to the axis, and then bending the part of the electrode between its ends into a curve.

The bending is preferably controlled by an anvil on one side of the electrode and by a mandrel on the other side, and the mandrel controls the axial position of the free end of the electrode to obtain the correct spark gap in the finished plug.

Because there are tolerances in respect of the dimensions of the side electrode itself and in respect of the attachment of the electrode, by welding, to the plug shell, it is important to first correctly position the free end of the electrode, before determining the curve by which the electrode free end is joined to the plug shell. In accordance with the invention, the radius of curvature of the curved part of the side electrode will vary from plug to plug, but the curvature of this part of the electrode is not critical to plug operation.

A second aspect of the invention provides apparatus for positioning the side electrode of a spark plug after the electrode has been welded to a cylindrical plug shell, the apparatus having a mandrel with a tip adapted to support the side of the electrode closest to the axis of the shell, an anvil, and means for providing relative closing movement between the mandrel and the anvil whereby the electrode is brought to its final position, characterised in

that the mandrel has means for supporting the shell on the mandrel at a predetermined axial position, and the anvil has a recess with an opening which faces the mandrel and with two working surfaces, the first surface being curved to guide the end of the electrode towards the axis of the shell and the second surface making an angle with the first surface so as to limit movement of the electrode end transverse to the axis of the shell.

The plug shell preferably has a through bore with a stepped diameter, and the mandrel then has a shoulder adapted to seat on the step to position the mandrel tip relative to the shell. Preferably when the centre electrode is positioned in the shell, it is positioned with reference to the same step so that the desired spark gap is achieved.

The first surface of the mandrel preferably has a curvature greater than the curvature to be imparted to the side electrode, so that the actual radius of curvature produced in the side electrode is not constrained by the anvil.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows, partly in cross section, a conventional spark plug; and

Figures 2, 3, 4 and 5 show sequential steps in the positioning of the side wire during manufacture of a plug in accordance with the invention.

The conventional spark plug shown in Figure 1 has a metal shell 10 with a hexagonal torque-receiving surface 12 at the upper end and a threaded section 14 at the lower end. A sealing washer 16 is carried on the shell 10. At the lower end of the shell is a side electrode 18 which consists of a length of Inconel wire welded at 20 to the bottom edge of the Inconel shell. Housed within the shell is a centre electrode 22 carried in an insulator 24. The side electrode 18 is bent towards the axis of the plug so as to form a spark gap 26 between itself and the centre electrode 22.

In the Figures 2, 3, 4 and 5 only the shell 10 is shown. The manufacturing steps illustrated in those figures are carried out prior to the insertion of the centre electrode 22 and the insulator 24 into the shell.

Figure 2 shows a mandrel and an anvil 30 arranged on an axis 32. A spark plug shell 10 is shown between the mandrel and the anvil, with the side electrode 18 in its initial, straight form. The shell 10 has an internal step 34, and the mandrel has a corresponding external shoulder 36.

The anvil 30 has a recess 38 with a first, curved surface 40 and a second surface 42 which forms an angle with the first surface and constitutes an abutment face.

Figure 3 shows how the shell 10 is fitted over the mandrel 28. The extent to which the mandrel tip 44 extends from the end of the shell is determined by the po-

sition of the abutment between the shoulder 36 and the step 34.

The mandrel 28 and the anvil 30 are then driven towards one another as indicated by the arrows 46, along the axis 32. Conveniently the motive force driving the two parts together can be produced from a hydraulic ram or rams.

As can be seen in Figure 3, the first contact between the electrode 18 and the anvil 30 is between the free end of the electrode and the curved surface 40. As the mandrel and anvil approach one another still further, the free end of the electrode 18 is forced to travel along the curved surface 40 until it reaches the abutment face 42 (Figure 4). At this point the electrode also comes into contact with a curved surface 48 on the mandrel 28. The presence of the mandrel at this point prevents the electrode 18 from being bent along a non-intended curve.

The position of the abutment face 42 determines the final transverse position of the free end of the electrode 18. Further closing movement of the mandrel and anvil causes the part of the electrode between its ends, where it is unconstrained, to be bent into a curved shape which is accommodated within the recess 38 and which approximately, but not completely, lies against the curved surface 40.

Finally, when the tip 44 of the mandrel comes into contact with the underside of the electrode 18, and the upperside of the electrode is in contact with the anvil, closing movement of the mandrel and the anvil is stopped. At this point the free end of the electrode is correctly positioned both axially and radially relative to the shell 10. The mandrel 28 is then withdrawn, and the spark plug assembly can be completed by inserting a centre electrode assembly inside the shell 10. The desired spark gap can be set by arranging that the centre electrode assembly references in the shell with the step 34, because the distance from this step to the electrode is accurately known as a result of the construction of the mandrel 28 and the forming process just described.

The correct radial, or transverse, positioning of the free end of the electrode 18 is of particular importance when an insert of a special material such as platinum is included on the electrodes, because the platinum inserts on the centre electrode and on the side electrode should line up for optimum performance. A method of inserting a platinum tip is known from our copending patent application number GB 2 234 920.

It will be noted in Figure 5 of the accompanying drawings that there is a gap between the first curved surface 40 of the anvil 30 and the final form of the side electrode 18.

This gap is present to allow any spare material of the side electrode between the top end of the shell 10 and the abutment face 42 to be accommodated without having any effect on the positioning of the electrode free end.

Claims

1. Apparatus for positioning the side electrode (18) of a spark plug after the electrode has been welded to a cylindrical plug shell (10), the apparatus having a mandrel (28) with a tip (44) adapted to support the side of the electrode closest to the axis of the shell (10), an anvil (30), and means for providing relative closing movement between the mandrel and the anvil whereby the electrode is brought to its final position, characterised in that the mandrel has means (34,36) for supporting the shell on the mandrel at a predetermined axial position, and the anvil has a recess with an opening which faces the mandrel and with two working surfaces (40,42), the first surface (40) being curved to guide the end of the electrode towards the axis of the shell and the second surface (42) making an angle with the first surface so as to limit movement of the electrode end transverse to the axis (32) of the shell.
2. Apparatus as claimed in Claim 1, characterised in that the shell (10) has a through bore with a stepped diameter, and the mandrel (28) has a shoulder (36) adapted to seat on the step (34) to position the mandrel tip (44) relative to the shell.
3. Apparatus as claimed in Claim 1 or Claim 2, characterised in that the first surface (40) of the anvil (30) has a curvature greater than the curvature to be imparted to the side electrode (18).
4. A method of positioning the side electrode (18) of a spark plug after the electrode has been welded to a spark plug shell (10), the method comprising the step of first bending the free end of the electrode (18) toward the plug axis (32), characterised by the further steps of stopping further transverse movement of the end relative to the axis, and then bending the part of the electrode between its ends into a curve.
5. A method as claimed in Claim 4, characterised in that the bending is controlled by an anvil (30) on one side of the electrode (18) and by a mandrel (28) on the other side.
6. A method as claimed in Claim 5, characterised in that the mandrel (28) provides an abutment (36) against which the electrode (18) is located to control the axial distance between the electrode and a reference point (34) on the plug shell.

55 Patentansprüche

1. Ein Apparat zur Anordnung der Seitenelektrode (18) einer Zündkerze nachdem die Elektrode auf ein

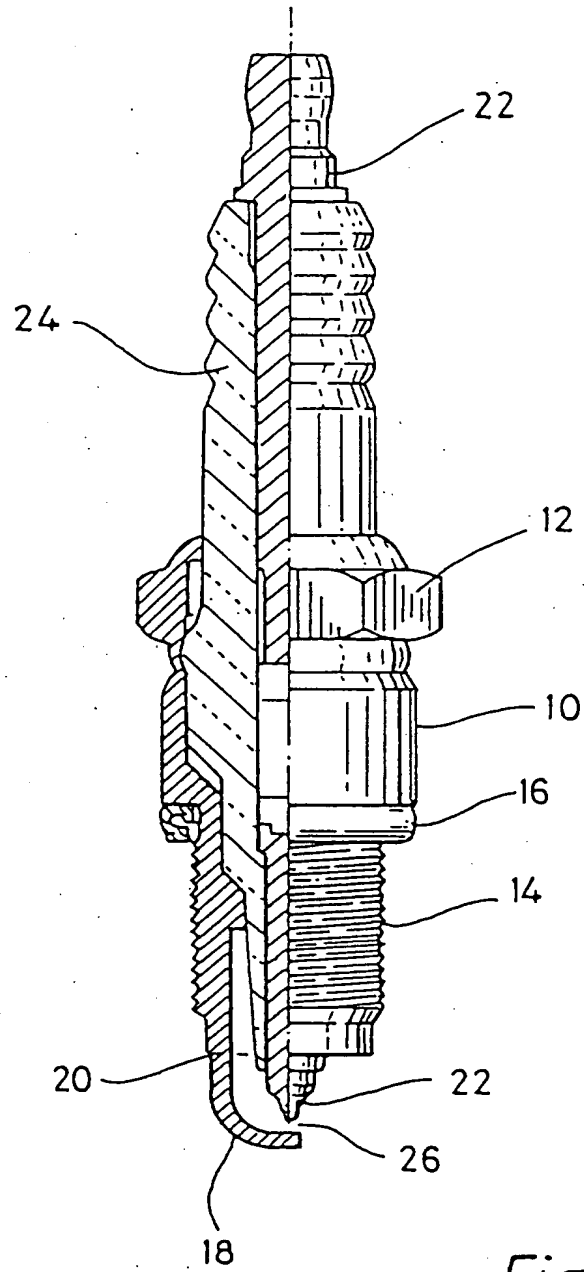


Fig. 1

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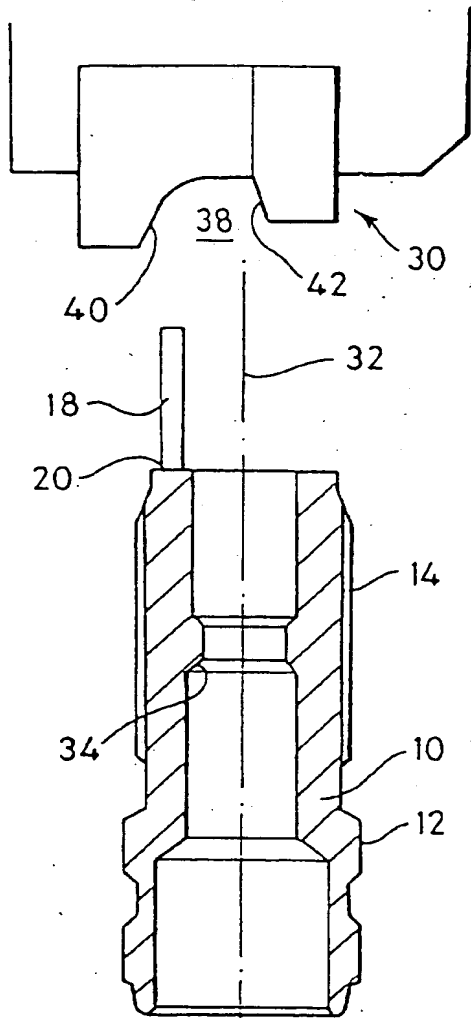


Fig. 2

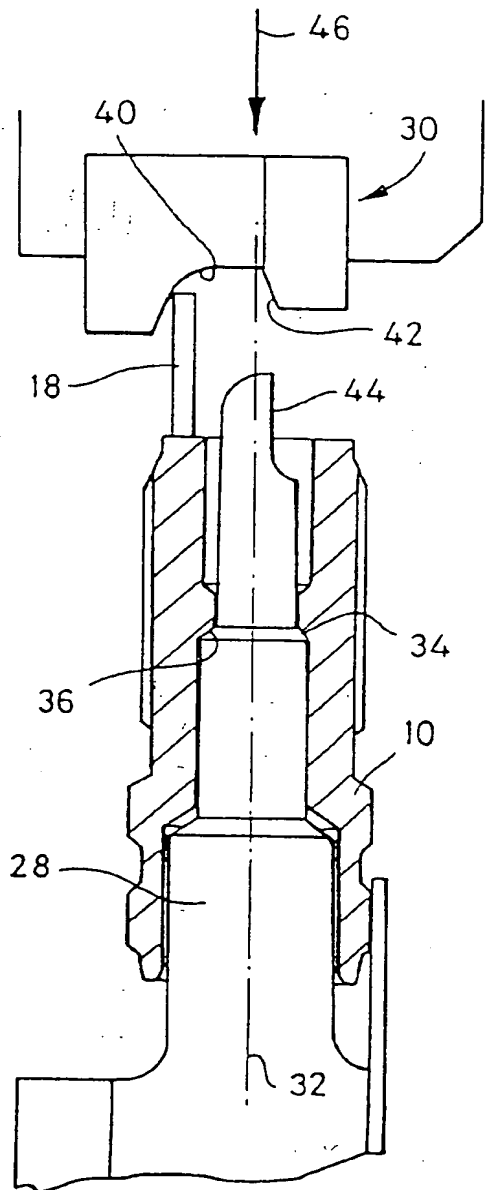
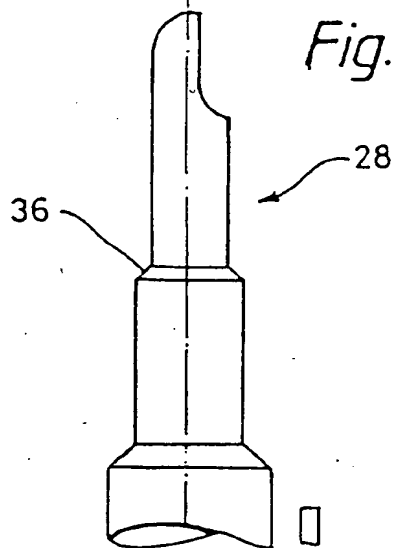


Fig. 3

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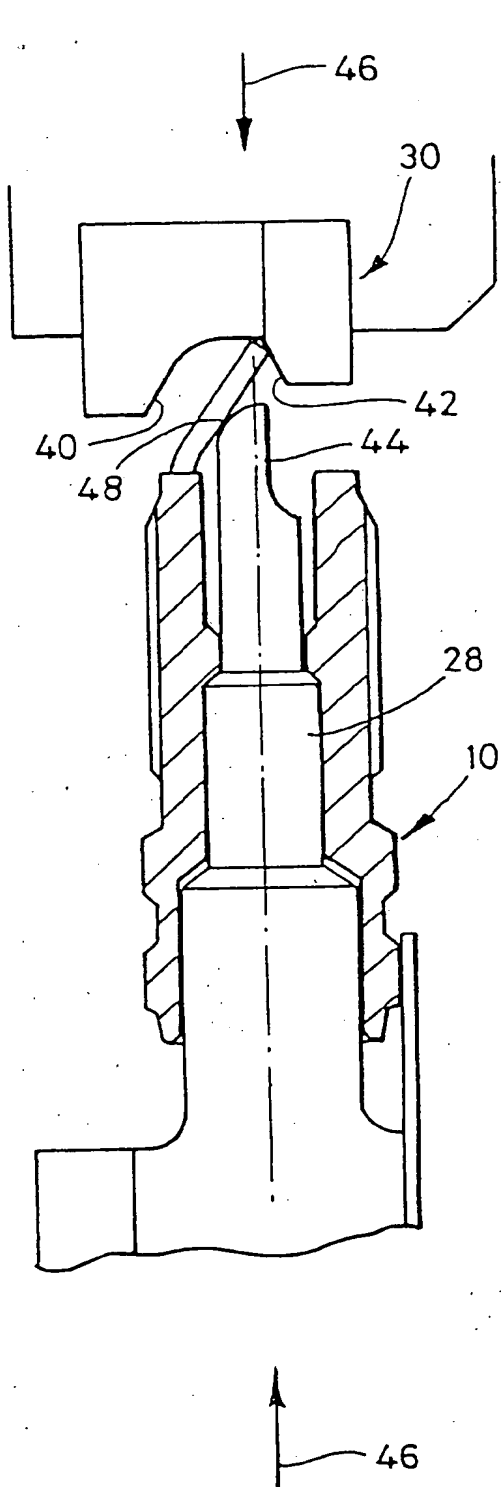


Fig. 4

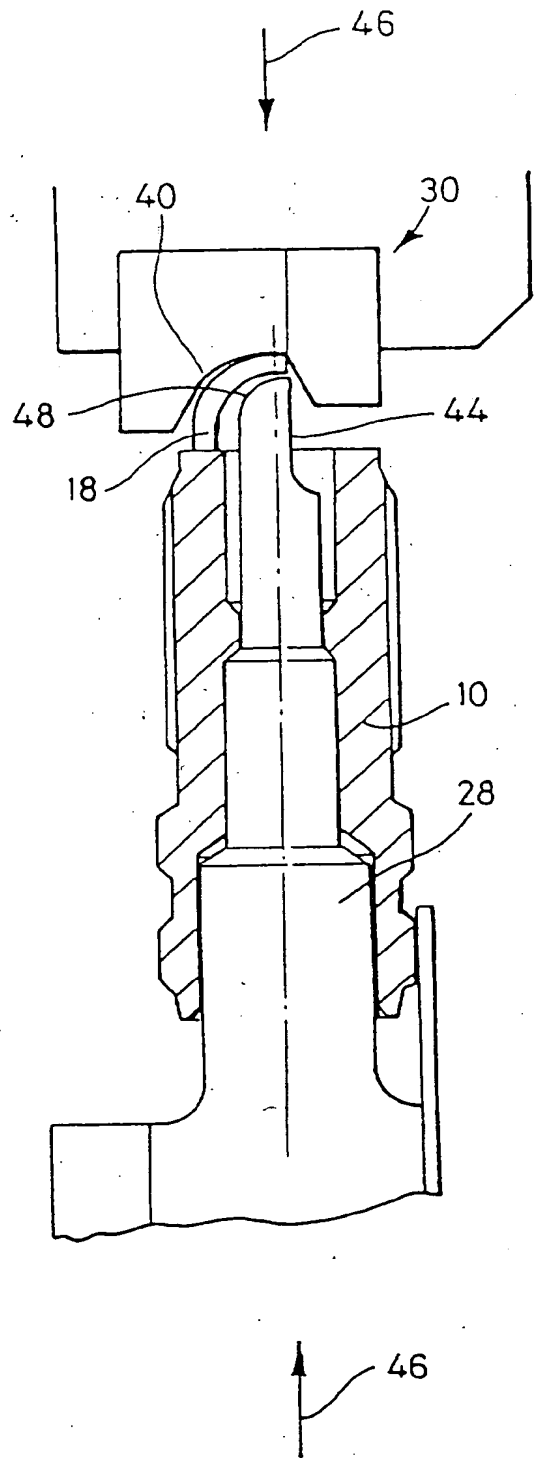


Fig. 5

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